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The dissemination of information from the UK Cleaner Coal technology programme in India (Phase II)

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Summary

With an increasing emphasis being placed on international collaboration in the development of cleaner coal technologies (CCTs), Future Energy Solutions (FES), on behalf of the UK Department of Trade and Industry (DTI) Cleaner Fossil Fuels Programme, aims to establish a CCT information dissemination network in India. TERI was selected to assist in this task. During Phase I of the project, a set of 13 publications from the UK Cleaner Coal Technology programme was selected by Future Energy Solutions (FES) for printing and dissemination in India in 2001, which was successfully completed. In the Phase II a set of 10 publications from the UK Cleaner Coal Technology programme was selected by FES for printing and dissemination in India in 2002.

The contacts database of key organisations in India for whom information on UK CCTs is needed was existing with TERI but it needed to be updated and checked for any change in contact information . Based on existing TERI contacts and further investigations, a database of 2,349 organisations was established.

The 10 publications selected by FES, together with a full list of publications available from the UK Cleaner Coal Technology programme was mailed to the identified organisations in three stages (see Table 2). A feedback form was sent with the last batch of publications, to all the target segments in the mailing list to identify the specific requirements of the various industry sectors for CCTs. Apart from publication we also disseminated Export Directory of UK cleaner coal technologies to select target audience.

Based on the feedback received, the project has been successful in establishing an effective information dissemination network in India. To date, 43 responses have been received. Feedback forms are still being received and this is expected to continue well into the coming months.

The industry sectors which responded to the CCT publications included power, cement, paper, steel, fertilisers, and engineering companies, aluminium, coal. Responses were also received from consultants, research institutes and industry affiliated organisations. The maximum queries were for more information on the UK CCTs and for other UK publications, particularly Technology Status Report, Project Summaries and Reports. With reference to future activities, many respondents wanted cleaner coal technology seminar with special reference to Indian scenario and wanted the information on CCT to continue.

Introduction

Future Energy Solutions (FES) manages the UK Cleaner Coal Technology Programme on behalf of the Department of Trade and Industry (DTI) UK. Technology transfer is an important part of the programme and a comprehensive publication and information dissemination network has been in existence for a number of years. With an increasing emphasis being placed on international collaboration in the development of cleaner coal technologies, FES aim is to establish a CCT information dissemination network in India. TERI has been selected to assist in this task. The Phase I of the project was successfully completed for the year 2001 which included 13 selected publications from FES. The Phase II of the project for 2002 includes 10 selected publications based on the previous year feedback, which were to be disseminated to the right contacts. Main activities for Phase II included:

i) the printing of 10 selected publications
ii) the establishment of a CCT publications dissemination network and mail-out of the printed publications together with a full list of UK CCT publications
iii) The maintenance of a small stock of 200 copies of each publication.
iv) The preparation and presentation of a brief review report including description of the dissemination network, the industry sectors targeted and any feedback received from the Indian coal and power generation industry.

Overview of coal in India

India is the fourth largest producer of coal in the world, with total coal reserves of 213 905 MT (million tonnes) (as on 1st January 2001) of which proven reserves are around 84 414 MT. Lignite reserves in the country are estimated at 34 168 MT. Coal is one of the primary sources of energy, accounting for about 67% of the total energy consumption in the country.

About 97% of the country's total coal production is attributed to national coal companies, of which Coal India Ltd accounts for 87% and the Singareni Collieries Company Ltd for 10%. [1]

With limited reserves of petroleum and natural gas, and the negative perception of nuclear power in the country, coal is expected to continue to play an important role in Indian energy generation.

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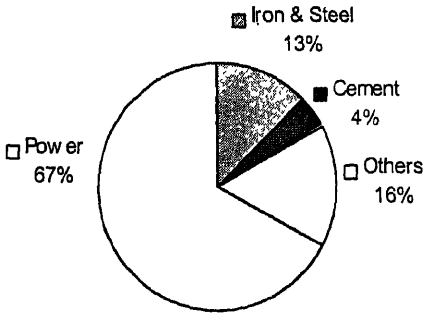
[1] TEDDY 2001/2002, TERI

Indian coal suffers from high ash content and low heating value. The quest for efficient and economic combustion of low quality coal has led to the development of innovative combustion technologies, which enhances combustion efficiency on the one hand, and reduce harmful emissions on the other.

Figure 1 shows the current coal consumption pattern in India [Coal in the Energy Supply of India, Coal Industry Advisory Board, International Energy Agency,2002][2]. Power generation is, by far, the most dominant market sector, consuming over two thirds of total production. Steel is the second largest market for coal followed by cement manufacture, another significant market. Other uses of coal include fertilisers, chemicals production, papermaking, sugar, etc.

Figure 1 Consumption pattern of coal in India (in billion tonnes)



Source: International Energy Agency / Organisation for Economic Co-operation and Development

The opportunities[3]

India's coal demand is projected to increase significantly in the next 5 years due to the completion of on-going coal based power projects, and demand from metallurgical and other industries.

The coal demand in the terminal year 2006-07 of the Tenth Plan is estimated at 448 MT. This implies an annual compounded growth rate of almost 5.2% in the 10th Plan as against as anticipated growth of 3.3% during the ninth plan (1996/9 to 2001/2002). The coal production target in 2006/07 is set at 405 MT leaving a deficit of 43MT, which would be met through imports. The domestic production has to increase from about 325 MT in 2001-2002 to 405 MT (an increase of 80 MT). This entails huge investment requirements, with an estimated 193 billion rupees.

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[2] Coal in the Energy Supply of India, Coal Industry Advisory Board, International Energy Agency, 2002.

[3] TEDDY 2001/2002, TERI, New Delhi and Tenth Plan

Foreign collaboration[4]

To meet country's growing demand for coal, foreign collaboration with the advanced coal producing countries are considered for,

- Bringing in new technologies both in underground and opencast sectors for efficient management in the coal industry, skill development, training, etc.
- Seeking bilateral funds for importing equipment which are not manufactured in the country.
- Bringing foreign financial assistance to meet the investment requirement.

Scope of foreign investment in the coal sector

The private Indian companies setting up or operating power projects as well as coal or lignite mines for captive consumption in such projects may be allowed foreign equity upto 100% provided that the coal or lignite produced by them is meant entirely for captive consumption in power generation.

100% foreign investment in the equity of an Indian subsidiary of a foreign company or in the equity of an Indian company for setting up of coal processing plants in India may be allowed, subject to the conditions that such an Indian subsidiary or the Indian company (a) shall not do coal mining, and (b) shall not sell the washed coal or sized coal from their Coal Processing Plants in the open market and shall supply the washed coal or sized coal from their Coal Processing Plants to the respective parties by sending raw coal to such Coal Processing Plants for washing or sizing.

The other private Indian companies engaged in exploration or mining of coal and lignite for captive consumption for production of iron and steel and production of cement may be allowed foreign equity upto 74%. Automatic approval of Reserve Bank of India for foreign direct investment in the equity of Indian Companies upto 50% in all the above cases may be allowed.

However, foreign direct investment beyond 50% in the equities of the private Indian companies engaged in activities of the nature indicated above should require approval of the Foreign Investment Promotion Board.

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[4] Annual Reports 2001/2002, Government of India, Ministry of Coal & Mines, Department of Coal

Opportunities open to the foreign investors

Some of the opportunities open to the foreign investors are:-

- Coal washeries: The demand for washed coal is on the rise on account of factors like increase in per unit coal consumption for power generation, maintenance of power generation equipment, reduction in transportation costs and concern for the environment. Coal beneficiation should be cost-effective in situations where the coal is required to be transported for power units located at a distance of more than 1,000 km from the coal mine.
- Equipment supply: Indian coal producing companies need the introduction of the latest technology both in underground and open cast mining and the supply of equipment by foreign manufacturers.
- Engineering services: It is usual for Indian companies to utilise the services of external specialists for planning and designing mines and monitoring of projects. Two areas where foreign technical assistance is much in demand are geotechnical assistance and hydrogeological evaluations of the deposit and mine production planning.
- Technology: The Government encourages investment by the private sector in adoption of clean coal technologies like Integrated Gasification Combined Cycle, Pressurised Fluidised Bed Combustion, Coal Beneficiation and Slurry combustion, and Coal Bed Methane exploitation.
- Underground mining assistance on the project for subsidence and strata control in multi-steam working in underground mines.

India's clean coal technology progress [5]

A good progress has been made in the technology for mining and beneficiation of coal. Growing environmental concerns and the need to improve conversion efficiency levels have led to keen interest in the development of CCTs in India. The technologies applicable are fluidised bed combustion (FBC) both bubbling and circulating, pressurised fluidised bed combustion (PFBC) for combined cycle application, and integrated gasification combined cycle (IGCC).

In India, gasification and fluidised bed combustion are of greater importance as these processes can help generate power with considerable improvement in efficiency, even from the low quality coal abundantly found in the country. IGCC technology compares favourably with other technologies. It is independent of the fuel quality. Depending on the type of gasifier refinery residues, slurries and coal can be used. IGCC technology is also environmentally friendly. Pollutants like sulphur dioxide (SO_2) and oxides of nitrogen (NO_x)are reduced to very low levels, without the implementation of downstream plant components and without additives like limestone. The low NO_X values are achieved by dilution of the purified syngas with nitrogen from the air separation unit and by saturation with water.

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[5] India's Clean Coal Technology progress
website: www.platts.comm/features//cleancoal/indiacct.shtml

Bharat Heavy Electricals Limited (BHEL) has been working on IGCC technology and has developed an appropriate gasification process for Indian coal feedstock. The company's research has focused on air-blown fluidised bed gasification owing to the high mineral matter in the coal.

In the first phase, a pilot scale pressurized fluidized bed gasifier (PFBG) was established for evaluation of gasification of high-ash Indian coals. Based on the state-of-the-art gasifier technology, it was decided to first develop the moving bed gasification process, followed by fluidized bed technology. Following this, a combined cycle demonstration plant (CCDP) of 6.2 MW capacity comprising a 4 MW gas turbine and 2.2 MW steam turbine was commissioned at BHEL Trichy during 1987. The coal gasification plant consists of a moving bed gasifier coupled with a wet gas clean-up system.

In the second phase, a 168t/d coal capacity PFBC demonstration plant was retro-fitted to the demonstration plant. The project was partly funded by USAID under the PACER programme, Pittsburgh Energy Technology Center (PETC) and IIT Chennai.

BHEL has also developed a 100 MW commercial IGCC plant comprising a gas turbine of 58MW capacity and a PFBC to supply low Btu coal gas. Low-grade, high-ash coal, normally available for power generation was selected as the fuel. After accounting for the auxiliary power consumption, the net generation from IGCC will be about 93MW with an overall cycle efficiency of 38%.

Printing and Dissemination of Publications from the UK Cleaner Coal Technology Programme in India

Selection of Publications

For Phase II dissemination of 10 select publications from the UK cleaner coal technology programme were selected by FES for printing and dissemination in India. The selections were based on information received from past technology transfer initiatives in India, including trade missions, inward delegations to the UK and participation in conferences and exhibitions and feedback received from Phase I. The selected publications are given below:

Technology Status Reports

- TSR014- Pulverised Fuel (pf) Flow Measurement and Control Methods for Utility Boilers.
- TSR015- Coal Preparation.
- TSR016- Coalbed Methane Extraction and Utilisation.

UK Capability Brochures

- CB009- Steam Turbines
- CB010- Pulverised Coal-fired Power Station Boilers.
- CB012- Coalbed Methane Extraction and Utilisation.
- CB002- Coal Preparation (Revised Edition)

Best Practice Brochure

- BP001- Longannet Power Station.

Project Summaries

- PS260- UK-China Coalbed Methane Technology Transfer.
- PS276- Review of Underground Coal Gasification Technology Transfer.

Printing of Publications in India

High-resolution PDF files for each publication was provided by FES. Each PDF file contained text, layout and illustrations for direct printing of the publications. All publications were printed on the same quality as the original UK versions and using an agreed quality of paper. TERI printed 2500 copies of each publications according to the specifications shown in Table 1.

For each publication, a preliminary proof version was sent to FES to check the overall quality before agreement was reached to proceed with the final print. On completion of the final print run, five copies of each publication were sent to FES for retention.

Table 1 Printing requirements for each document type

Publication	No. of Pages	Cover	Print quantity	Page Weight (gsm)	Paper Type
Technology Status reports (3)	12 + Cover	Art Laminated (280gsm)	2500	130	Matt art
Best Practice Brochure (1)	6/8 + Cover	Satin (170gsm)	2500	130	Matt art
UK Capability Brochures (4)	7/8 + Cover	Art Laminated (280gsm)	2500	130	Matt art
Project Profiles (2)	1	-	2500	130	Art

Table 2 shows the actual project time schedule for the printing, approval and dissemination of each publication.

Table 2 Project time schedule (May 2002 to August 2002)

First Print (Publications)	Printing	Approval from AEA	Final Printing	Dissemination
TSR014 TSR015 CB009 PS260	18th June	29th June	10th July	1st August (Covering letter send, see annex 1)
BPB001 TSR016 CB010 PS276 CB002 CB012	29th July	10th August	25th August	10th September
Export directory of UK cleaner coal technologies 3rd edition	------	----	-------	15th september

Stock Maintenance

After initial dissemination of publications, a small stock of about 200 copies of each publication were retained for any future dissemination. The current stockholding of each publication is shown below:

Table 3 Stockholding of publications

Publications	Stock holding(as on 10/11/02)
TSR014	175
TSR015	190
TSR016	183
CB002	169
CB009	210
CB010	193
CB012	214
BP001	189
PS260	176
PS276	191

Selection of Target Sectors

The following target sectors were identified:

- coal and power generation industries
- industrial/commercial/domestic coal suppliers and major users
- local economic and trade commissions in the major coal-producing and coal consuming districts
- environmental protection agencies
- government coal administrations
- import and export organisations.

The following table shows the distribution of addresses within the database for each target sector:

Table 4 Target sectors

Sector No.	Descriptor	Rating*	No. of Addresses
1.	Ministry of Coal	High	10
2.	Power and Coal	High	912
3.	Iron and Steel	High	305
4.	Textiles	Average	135
5.	Cement Manufacturers	Average	190
6.	Paper and Pulp	Average	140
7.	Sugar Mills	Average	60
8.	Government Administration	Average	72
9.	Indian Exporters	---	65
10.	Indian Importers	---	41
11.	New Projects (Thermal Power)	High	45
12.	Ministry of Power	High	21
13.	Environment Agencies	----	80
14.	Consultant	----	60
15.	Engineering Companies	----	50
16.	Research Institute	----	60
17.	Chemical Industry	----	77
18.	Fertiliser Industry	----	26
TOTAL			2349

* based on coal consumption on general judgement

The range of contacts identified within each target segment included: Managing Directors, Executive Directors, Chairmen, Advisors, Secretaries, Environmental Managers, Project Managers, Works Managers, Ministers, Exporters and Importers. Each batch of publications was sent out to the above organisations with a covering letter (see Annexe 1).

Analysis of Feedback

A questionnaire was prepared through consultation with FES (see Annexe 2) and this was sent out with the last batch of publications on 10th September 2002. To date, we have received 43 enquiries (see Annexe 3), 39 being by post and 4 by E-mail, which is 1.87%. Enquiries are still being received and this is expected to continue over the coming months. However, the analysis of feedback received till date is given below.

Power

The total response in this sector was 14. We have studied the feedback on the individual organisation information need and tried to make the analysis as simple as possible for readers to know the actual requirement of each target segment. Almost all the respondents requested more information on CCTs, specific to their areas of interest (see Table 5) and expressed their wish to participate in seminars and missions, both to and from the UK.

Organisation : National Thermal Power Corporation
Status : Public Sector Unit (Government of India)
Sector : Power Generation

Total Response :4

Professionals (project development)

➢ *Study/project conducted in the organisation*

- Super critical technology is being introduced
- IGCC-FR being prepared
- In the process of coal gasification technology in Indian coal and to use it in the gas turbines.

Specific interests/requirements relating to CCTs

- NTPC already ties up with USAID for installing 100 MW IGCC plant in Dadri near Delhi.
- Super crictical, IGCC and low emissions.

Future activities

- Missions, Seminars and receipt of all publications and books.
- Power generation and IGCC activities.

➢ *General comments*

- The publications have outstanding quality both in terms of contents and presentations. The langauge is easy to grasp and conveys current status of different technologies.There is a need to propogate and involve more people in the commendable efforts DTI is making in this area, which is particularly relevant in the current scenario wherein there is a need to balance the high energy demand and its effect on environment. Countries like India should be focussed on as new generating capacity is being added at a great speed. Hence it has great market for such services.

- Provide detail of techno-economic analysis and the ultimate analysis of coal used.
- If it comparable with our coal are can think of a transition in technology and achieve a better efficient system in which specific heat input reduces.

Professionals (Planning/ Environment consultant)

➢ *Specific interests/requirements relating to cleaner coal technologies.*

- Suspended Particulate Matter (SPM) reduction
- NO_x reduction
- Combustion optimization
- Efficiency improvement
- Environmental monitoring
- Flue gas conditioning

➢ *Future activities*

- All programmes related to environmental management.

Professional (Manager, Fuel Management)

➢ *Specific interests/requirements relating to cleaner coal technologies*

- Coal washing
- Coal blending
- IGCC
- PFBC

Organisation : Reliance Industries Ltd
Status : Private company
Sector : Power Generation (Oil, gas, CBM.UCG)
Total response: 2

Professional (project development)

➢ *Study/projects conducted in the organisation*

- Coal bed methane resources of India
- Underground coal gasification techniques and possible areas for its application in India

➢ *Study/project conducted on CCT after receiving 13 publications (Phase I)*

- Project on CBM resources in India
- Underground coal techniques and possible areas for its application in India.

➢ *Specific interests/requirements relating to cleaner coal technologies*

- Coal bed Methane and Underground coal gasification techniques & its application gas based power generation.

➢ *Future activities*

- Coal bed methane and Underground coal gasification.

Organisation : Aditya Birla Group
Status : Private company
Sector : Power generation, Non-ferrous metals, Cement industry.

Professional (Project development)

➢ *Study/project conducted in the organisation*

- Coal washery feasibility study for Ashoka Mine (North Karanpura) Jharkhand.

➢ *Specific interests/requirements relating to cleaner coal technologies*

- Coal benefication of Indian Coal (high ash) for use in power plants.

➢ *Future activities*

- Coal preapartion, coal washing, ash utilisation, Pulverised coal fired, Power station efficiency improvement.

➢ *General comments*

- Useful literature. There should be more interaction between Indian and UK coal users specially for power plants.

- UK companies should assist their Indian counterparts in finalising a long term legally enforceable coal supply agreement model to be entered into between a coal supplier & an utility.

Organisation : Siemens Ltd
Status : Private Company
Sector : Power Generation

Professional (Project development)

➢ *Study/project conducted in the organisation*

- Siemens AG, parent company of Siemens Ltd, has extensive experience in IGCC power projects.

➢ *Study/project on cleaner coal technology after receiving 13 publications (Phase I)*

- Continuously works on several fronts including IGCC.

➢ *Future Activities*

- IGCC, Advanced PF (supercritical)
- Gas turbines

Organisation : Spectrum Power Generation Ltd
Status : Private Company
Sector : Power Generation

Professional (Project development)

➢ *Specific interests/requirements relating to CCT*

- The company intends to develop coal/gas based power plants in Andhra Pradesh.

➢ *Future activities*

- Seminars on clean coal program to be held in India

➢ *General comments*

We need latest technologoical developments in setting up coal/gas based power plants and their operation and maintenance.

Organisation : NOIDA Power Company Ltd
Status : Private Company
Sector : Power Distribution

Professional (Operations/Commercial)

➢ *General comments*

Would like to receive more information on UK cleaner coal Technology Programme.

Organisation : Jindal Steel & Power Ltd
Status : Private company
Sector : Power Generation, Coal Mining, production and Steelmaking.

Professional(Project Development)

➢ *Specific interests/requirements relating to cleaner coal technologies*

- Would like to get the details of circulating fluidised bed boilers (CFBC)

➢ *Future activities*

- Would like to attend seminars and presentations on coal utilisation and usage.

➢ *General comments*

We are using lot of coal for steel manufacturing and power generation. We have installed numbers of AFBC boilers for power generation for reducing the environmental pollution.

We have installed coal washeries and rejected coal of washeries are being used for power generation.

Organisation : Kalinga Power Corporation
Status : Private company
Sector : Power Generation

Professionals (Project development and overall management)

- Specific interests/requirements relating to cleaner coal technologies
  - We feel that in all these hypes (in reference to cleaner coal technologies promotion materials) economics has taken a back seat. We want proof that private power generation will be viable with the technology , examples of such power stations are to be given.

- *Further understanding of CCTs and about the CCTs offered by UK companies*
  - No, we thought these are business promotion publications. We did not get any literature on their mass use in UK and the economical benefits there of if any.

- *Publications request*
  - List of publications specially application in power generation with proved economic benefits.
- *Future activities*
  - Yes, In seminars organised in India dealing not with technology but with economical issues & viability in private power generation.

- *General comments*

TERI with the UK organisations should take a specific power project with CCT and establish its economical viability with the purchasers of private power.

Organisation : Haryana Electricity Regulatory Commission
Status : Local Government
Sector : Power generation, power transmission and distribution.

- *Specific interests/requirements relating to cleaner coal technologies.*
  - Besides new projects, We would be interested in knowing about the options available to convert old coal based thermal power plant to cleaner coal technologies- from technical as well as economic consideration.

Organisation : Chattisgarh Electricity Co. Ltd
Status : Local Government
Sector : Power Generation and Coal Mining and Production.

Professional (Other, coal mining and power plant)

➢ *Specific Interests/requirements relating to cleaner coal technologies*

- A mini plant converting coal to coke and the gas generated to be used in boiler for steam generation.

➢ *General comments*

Very good information is available in the respect of cleaner coal technology which is essentially needed for utilisation of high ash content in Indian coals.

Organisation : Bharat Heavy Electricals Ltd
Status : Public Sector Unit (Government of India)
Sector : Power Generation

Total response: 2

➢ *Study/project conducted in the organisation*

- Fluidised bed coal combustion

COAL

Organisation : Central Mine Planning & Design Institute Ltd
Status : Public Sector Unit (Government of India)
Sector : Coal mining and production
Total response: 3

Professional (Planning/Environment consultant)

➢ *Study/project conducted in the organisation*

- Study of effect on surface structures due to blasting induced vibrations.
- Stabilisation of inaccesible underground waterlogged voids by hydro-pneumatic sand stowing

➢ *Specific interests/requirements relating to CCTs*

- Fast rate of filling of waterlogged inaccessible void from surface.

- Delineation of underground void from surface.

➢ *Cleaner coal technologies areas of interest*

- Study on fly-ash disposal in opencast voids
- New techniques of ambient air quality sampling and analysis in coal mines.
- Case study on noise-attenuation in mining areas
- Case study on technical and bio-reclamation of OB dumps and subsided areas

➢ *General comments*

The techniques of FBC, CBM extraction, coal gasification, coal preparation and utilisation, coal blending, etc. Already being practised in our subsidiary companies.

Organisation : Coal India Limited
Status : Public sector unit (Government of India)
Sector : Coal Mining and Production

➢ *Study/project conducted in the organisation*

- Yes, funded Science & Technology project on IGCC

➢ *Specific interests/requirements relating to cleaner coal technologies*

- Yes, CBM, carbon capture & storage, carbon sequestration in geological formations especially in coalbeds.

➢ *Future activities*

- Mission to UK, seminar on green power, environment, climate change etc.

Organistaion : The Singareni Collieries Company Ltd
Status : Public Sector Unit (Government of India)
Sector : Coal Mining and Production

➢ *Study/projects conducted in the organisation*

- Yes, Radiometric detection & automatic removal of stones/shale technology for dry benefication of coal at YCHP, Yellandu project was conducted on trial operations.

➢ *Specific interests/requirements relating CCT*

- Yes, Details on coal benefication for establishing washery to improve the grade by reducing the ash content with particular reference to high ash content coals in SCCL.

➢ *Future activities*

- Yes, To update knowledge on coal washery by attending seminar and study tours.

➢ *General comments*

The information given in the ten publications has given an insight to the latest development in UK with respect to coal based power generation clean coal technology connected to and other broad strategy being adopted worldwide.
If there is any special publications on coal benefication with respect to non-coking coal used for power generation gives a broad view of relavance of various technologies for washing of coal, it will be more benefit and useful for the coal producers and also for coal consumers.

CEMENT

Organisation : Zuari Cement Ltd
Status : Private Company
Sector : Cement Industry

Professional(Administration/General Management)
Would like to receive more mail-out information on UK Cleaner Coal Technology Programme.

ACADEMIC/RESEARCH INSTITUTES

Organisation : Indian Institute of Technology, Kharagpur
Status : Academic Institution (Government of India)
Sector : Academic institute engaged in Research on coal combustion, gasification, coal washing etc.

Total Response: 4

Professional(Project Development/Researcher)

> *Study/project conducted in the organisation*

- Yes, Pulverised coal combustion, Fluidized bed combustion, coal gasification, Pressurised circulating Fluid bed Combustion.

> *Specific interests/requirement relating to CCT*

- Yes, interest in coal beneficiation combustion & gasification.

> *Future activities*

- Yes, in areas of coal combustion/gasification and modeling of PF fired combustion.

> *General Comments*

The department of chemical engineering is engaged in teaching and research on coal utilisation, benefication & liquefaction since last four decades. The department used to run a post graduate course in Coal Processing Engineering in the eighties. A large number of Master and Phd dissertation projects were completed on various aspects of coal utilization. In addition a large number of sponsored and consultancy projects were completed. The important sponsored projects completed during the last ten years include:

- TCTP programme on coal utilization under UK government and British Council.
- Technical & academic linkage programme on combustion studies on coal-sponsored by Canadian International Development Agency, Canada, & Technical Universities of Novascotia, Canada.
- Hydrogasification of coal for high BTU gas.
- Mechanism and combustion of coal in Batch Fluidized Bed Combustor.
- Prolysis and combustion of coal & biomass in combustors.
- Hydrodynamic studies in a pressurized Fluidized Bed Combustion- (in progress).
- Simulation of coal washing circuits.
- Injection of coal in blast furnaces.
- Flotation characteristics of Indian coals and studies on column flotation.
- Non-Newtonian character of coal/water/oil slurries and their transportation in pipeline.

Organisation : Central Glass & Ceramic Research Institute
Status : Research Institute
Sector : Glass & Ceramics

Professional (Researcher)

➢ *Study/project conducted in the organisation*

- Smoke pollution control in the coal fired glass melting furnaces.
- Development of energy efficient coal fired Down Draft kiln with pollution control.
- Development of coal fired Low Thermal Mass (LTM) kiln.

➢ *Specific interest/ requirements relating to CCT*

- Replacement of coal firing by producer gas firing
- Designing of low thermal mass energy efficient kilns with generated producer gas.

➢ *Publication most useful*

- Underground Coal Gasifaction, want to have more information on this subject.

➢ *Future activities*

- Wants to get involved in any of the cleaner technologies related to coal firing with special interest to small scale coal fired glass and ceramics furnaces.

Organisation : National Productivity Council
Status : Consultancy Organisation (Government of India)
Sector : All

Professional(Planning/Environment Consultant)

➢ *Future Activties*

- Interested to join the mission.

➢ *General comments*

It was noted that some of the publications were old.We expect latest information & more relevant information with respect to developing countries. The information should have direct applicability. Why don't we get more case studies on what has been done in developing countries & results there of.

Organisation : Shramik Vidyapeeth
Status : Academic Institute (Vocational Training Institute)
Sector : Coal mining and production / Power Generation

Professional(Planning/Environment consultant)

➢ *Study/project conducted in the organisation*

- Yes, we have conducted one day seminar on Environmental monitoring in Khelari Coal Mines Area

➢ *specific interest/requirement relating to CCTs*

- About gasification (Town gas) and Domestic coal uses.

➢ *Future activities*

- Yes, In the area of classification (Town gas) ash utilisation and coke manufacturer.

➢ *General comments*

Seminars and workshops must be organised in Jharkhand state on cleaner Coal technologies Programme.

ENGINEERING

Organisation : Thermax Limited
Status : Engineering Company
Sector : Coal Mining and Production/
Power Generation/steelmaking/
Non-ferrous/Chemical Manufacture/
Cement Industry.

Professional(Administration/General Management)

➢ *Study/project conducted by the organisation after receiving 13 publications in Phase I*

- Yes, the division primarily works on gas cleaning plants for boiler flue gas. We have supplied to our customers Electrostatic Precipitators and FGD for particulate matter and SO2 control.

➢ *Specific interests/requirements relating to cleaner coal technologies*

- Air pollution control and in particular reduction in Sox and Nox emission.

➢ *Future activities*

- Yes, related with " air pollution control" and CO_2/SO_2 trading as per KYOTO PROTOCOL.

➢ *General Comments*

The literature is informative and to the point.

CONSULTANT

Organisation : Engineers India Limited
Status : Public Sector Unit (Government of India)
Sector : Power generation/ Non-ferrous metals/ Chemicals Manufacture/Petroleum Refining

Total Response: 3

Professional (Planning/Environment Consultant)

➢ *Study/project on CCT after receiving 13 publications (Phase I)*

- Review of usage of petroleum residue along with coal

➢ *Specific Interests/requirements relating to CCTs*

- Co-firing of petroleum residue along with coal in PF especially petroleum coke.

Organisation : Engineering Projects (India) Ltd
Status : Public Sector Unit
Sector : Coal mining and production/power generation/ steelmaking

Professional (Project development)

➢ *Further Understanding of CCTs and about the CCTs offered by UK companies*

- We are going through these publications. Depending upon the specific requirement of project, these publications will be very useful. These publications contain a very useful information about coal and its varied applications and also the treatment of coal.

> *Future Activities*

- It will depend on the specific requirement of the project/feasibility report etc. which we may involve ourselves.

> *General comments*

- We would like to have publications in the field for water, environmental waste water management, other energy related publications.

Organisation : Consulting Engineering Services (India) Pvt. Ltd
Status : Private Company (Consultancy Organisation)
Sector : Power generation/Infrastructure development

Professional (Planning/Environment consultant)

> *Specific interests/requirements relating to CCTs*

- Technologies for reduction/control of emissions of SO_2, NO_x and particulate matters.
- Underground coal gasification and its potential environmental impacts.

> *Future Activities*

- Ash utilisation and emission reduction in power plants

> *General comments*

- More information on the environmental aspects of technologies and successful commercialisation of environment friendly technologies would be welcome.

PAPER

Organisation : Soma Papers & Industries Ltd
Status : Private Company
Sector : Paper Industry

Total Response: 2

Professional (Project Development)

> *Specific interests/requirements relating to CCTs*

- Interested in the use of coal for generation of power & heat and would like to avoid emission of ash & dust from chimney.

➢ *Further understanding of CCTs and about the CCTs offered by the UK companies*

- No, the publications were meant for coal mining or for use of methane gas whereas our need is only for clean burning of coal.

Organisation	: Ruchira Papers Ltd
Status	: Paper Manufacturer
Sector	: Paper Industry

➢ *General Comments*

- Would like to receive more mail-out information on the UK Cleaner Coal Technology programme.

STEEL

Organisation	: Tata Steel
Status	: Private Company
Sector	: Coal mining and Production/Power generation/steelmaking

Professional(Planning/Environment Consultant)

➢*Specific interests/requirements relating to CCTs*

- Reduction in ash percentage.

ALUMINIUM

Organisation	: Indian Aluminium Company Ltd
Status	: Government of India
Sector	: Coal mining and Production/Power generation/Non-ferrous Metals

➢ *Specific interests/requirement relating to CCTs*

- We are taking measures in our upcoming coal mine to use at least good mining machines like ripper dozers for coal preparation. We are also running CFBC boiler which is considered to be environment friendly and of higher efficiency. Copies regarding coal bed methane are aslo quite interesting.

➢ *Publications most useful*

- Yes, publication on equipment like surface miner, instruments for measurement of coal quality, coal bed methane are useful to us.

➢ *Future activities*

- Yes, on CFBC boilers and IGCC technology mainly.

➢ *General comments*

- We would like to get more ideas on CFBC boilers. Any assistance on IGCC, etc. will also help us.

FERTILIZER

Organisation : The Fertiliser association of India
Status : Industry Association
Sector : Chemicals Manufacture
Professional (Planning/Environment Consultant)

➢ *Study/project conducted by the organisation*

- Part of the task force set up by Governmnet of India for coal as feedstock for manufacture fertiliser.

➢ *Specific interest/requirements realting to CCTs*

- Coal gasifaction for making synthesis gas for manufacture of ammonia.

➢ *Future activities*

- Yes, seminar/visits related to coal gasification.

Industry affiliation

Organisation : Confederation of Indian Industry
Status : Industry Apex Body
Sector : Working across all sectors.

Professional(Researcher)

➢ *Study/project conducted by the organisation*

- We have organized an International Seminar on "Fossil Fuel Generation" where CCT was main focus.

Table 5 CCTs: areas of interest shown by different sectors

CCT Areas of Interest	Industry	Power	Cement	Consultant	Coal	Research	Ind Affil	Engng	Paper	Fertilizer	Steel
Coal Exploration	√	√									√
Coal Mining		√		√							√
Coalbed Methane		√		√	√	√	√				√
Coal Handling/supply	√	√		V	√	√			√		√
Coal blending, sizing	√	√	√	√	√	√					
Coal Washing	V	√		√	√	√					√
Coal Briquetting		√		√		√			√		
Coal Liquefaction	√	√		√	√	√	√				
Steel making				√		√		√			√
Coke Manufacture		√		√		√		√			√
Cement Manufacture		√	√	√		√		√			
Coal Gasification (Chemicals)	√	√		√		√	√			√	√
Gasification (town gas)		√				√					√
Ash utilisation	√	√	√	√	√	√		√	√		√
Underground Coal Gasification	√	√		√		√	√		√		√
Industrial Boilers		√		√		√	√	√			
Power Gen. (Combustion)	√	√		V		√	√		√		√
Power Gen. (Gasification)	√	√		√		√	√		√		√
Steam Turbines	√	√		√		√	√		√		√
Gas Turbines	√	√		√		√	√				
Conventional PF	√	√		√		√	√				
Advanced PF (Supercritical)	√	√		√		√	√				
PFBC	√	√		√		√	√				
CFBC	√	√	√	√		√	√				√
ABGC	√	√		√		√	√				
IGCC	√	√		√		√	√			√	√
Emissions (SO$_2$,NOx, part)	√	√	√	√	√	√	√	√			√
Other Indl Coal Uses	√	√	√	√		√					
Domestic Coal Uses		√				√					
Retrofitting & Refurbishment	√	√				√					
CO$_2$ Caputre & Storage	√	√	√	√	√	√	√				√
Other		√		√	√						

Table 6. Publication requested from FES by target segment

Publications	Power	Cement	Coal	Research Institute	Steel	Others
Case Studies						
CS001		√				√
CS005					√	√
CS006					√	
CS007	√				√	
Technology Status Report						
TSR001			√	√		
TSR002			√			
TSR003			√		√	
TSR004					√	
TSR006			√	√		
TSR008						√
TSR009					√	
TSR0010						√
TSR011	√	√			√	√
TSR012	√					
TSR013	√					√
TSR015					√	√
TSR017		√				√
UK Capability Brochure						
CB002					√	√
CB003					√	
CB004	√			√		
CB007					√	
Project Profiles						
PP007						√
PP029					√	
PP080					√	
PP084					√	
PP085					√	
PP089					√	
PP101					√	
PP243					√	
PP264					√	
PP272					√	
PP285					√	
PP289					√	
PP292					√	
PP293					√	
PP294					√	
PP307					√	
PP317					√	
Project Summaries						
PS013					√	
PS015					√	
PS023					√	
PS027		√			√	
PS028					√	
PS037					√	
PS038	√					
PS041					√	

Publications	Power	Cement	Coal	Research Institute	Steel	Others
PS049					√	
PS050					√	
PS051		√			√	
PS063					√	
PS068				√		
PS097					√	
PS106					√	
PS109		√			√	
PS110					√	
PS111						√
PS114					√	
PS129					√	
PS130					√	
PS131	√					
PS132					√	
PS136					√	
PS152		√			√	√
PS160					√	
PS177					√	√
PS180				√		
PS201					√	
PS203					√	
PS204					√	
PS226					√	
PS233						√
PS242						√
PS246					√	
PS247					√	
PS261					√	
PS263						√
PS265					√	
PS276						
PS282					√	√
Report						
R005						√
R007						√
R013	√					
R017	√				√	
R020	√					
R022					√	
R028						√
R036						√
R045						√
R046						√
R049					√	
R051			√			
R052					√	
R059					√	
R063					√	
R068					√	
R070					√	
R085					√	
R092				√		
R139				√		
R155					√	

Publications	Power	Cement	Coal	Research Institute	Steel	Others
R166						√
R173					√	
R174					√	
R176					√	
R177			√		√	
R179					√	
R184						√
R187		√				
R188		√			√	
R199				√		√
R208						√
R209						√

CONCLUSIONS AND RECOMMENDATIONS

India is the fourth largest producer of the coal in the world, with total coal reserves of 213 905 MT (Million Tonnes) (as on 1st January 2001) of which proven reserves are around 84 414 MT. Lignite reserves in the country are estimated at 34 168 MT. Coal is one of the primary sources of energy, accounting for about 67% of the total energy consumption in the country.

About 97% of the country's total coal production is attributed to national coal companies, of which Coal India Ltd accounts for 87% and the Singareni Collieries Company Ltd for 10%.

Indian coal suffers from high ash content and low heating value. The quest for efficient and economic combustion of low-quality coal has led to the development of innovative combustion technologies, which enhance combustion efficiency on the one hand, and reduce emission on the other.

Growing environmental concerns and the need to improve conversion efficiency levels have prompted the development of Cleaner Coal Technologies (CCTs) in India and, currently, six countries are working in India in this important technology area.

As part of its aim to strengthen collaboration with India in the development of CCTs, the UK Cleaner Coal Technology Programme initiated this project to investigate the feasibility of establishing a CCT information network in India for the Programme. For this initial project, 13 publications were selected from the UK Cleaner Coal Technology Programme based on past experience of the Indian market. TERI was selected to undertake this work and the publications were printed in India and disseminated to the specific target segment who have their interest in coal production and utilisation successfully completed in the year 2001. For the Phase II project Future Energy Solutions selected 10 publications to be printed and disseminated to the updated list of last year target segments in the India.

High resolution PDF files for each publication was provided by FES. Each PDF file contained text, layout and illustrations for direct printing of the publication. All publications were printed on the same quality as the original UK version, using an agreed quality of paper. For each publication, a preliminary version was sent to FES to check the overall quality before agreement was reached to proceed with the final print.

The target organisations were carefully selected on the basis of their involvement in coal sector in India. A total of 43 responses were received.. In general, the respondents wanted more information on relevant technologies related to their specific industry requirement.

The industry sectors which responded to the CCT publications included power, cement, textiles, paper, fertilizer, steel and chemicals and engineering companies. Responses were also received from consultants, research institutes and industry affiliated organisations. The most encouraging response came from the power, and cement sectors. The most common requests were for Project Profiles and Project Summaries, with many organisations wanting more information on the UK CCTs. With reference to future activities, a number of respondents wanted seminars and expressed a wish to participate in developing a CCTs Programme in India.

Based on the feedback received, the following recommendations are made:

1. More information on CCTs programmes is needed by the different industry sectors
2. Key technologies for each specific sector should be identified from the feed back received.
3. Publications should be identified and targeted for specific industry sectors for maximum benefits.

DISSEMINATION OF INFORMATION FROM THE UK CLEANEI COAL TECHNOLOGY PROGRAMME IN INDIA (Phase II)

Dear Participant

Please find enclosed some publications from the UK cleaner coal technology programme. This is part of the Phase II dissemination of information from th UK Cleaner Coal Technology programme in India. Technology transfer is an increasingly important part of the programme and these activities are manage by ETSU on behalf of the UK Department of Trade and Industry. With an increasing emphasis being placed on international collaboration in the development of cleaner coal technologies (CCTs), ETSU aims to establish a CCT information dissemination network in India. TERI has been selected to assist in this task.

Over the next three months, you will be receiving further publications from UK cleaner coal technology programme which I am sure you will find useful have also enclosed a full list of publications from the programme. If you req copies of any of these or further copies of the publications enclosed, please ' get back to me.

We are also interested in receiving feedback on the publications and would grateful if you could send any comments or enquiries to me at the address be Alternatively, you could contact the UK programme direct using the contact details on the publications. Another useful point of contact would be the DT CCT web site address, also shown on the publications.

Many thanks for your attention.

Kind regards

Beena Menon
Manager
Information Dissemination

DISSEMINATION OF INFORMATION FROM THE UK CLEANER COAL TECHNOLOGY PROGRAMME IN INDIA (Phase II)

(Feedback Form)

Dear Participant

TERI is assisting the UK Department of Trade and Industry in a project which aims to establish a Cleaner Coal Technology (CCT) information network in India. As part of this project, you would have received a number of publications from the UK Cleaner Coal Technology Programme. An aspect of this work will be to evaluate feedback from these publications in order to enable future activities to be more targeted towards the interests and CCT needs of India. I would greatly appreciate it therefore if you could complete the enclosed feedback form and mail it back to me at the earliest.

Kind regards

Beena Menon
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TERI
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CCT PUBLICATIONS - FEEDBACK FORM
AUGUST 2002

Name:...

(Alternatively enclose your business card)

JobTitle:...

Company/Organisation:..

Address:...

....

....

Telephone:...................................Fax:..

E-mail:..

About you, the Participant and your interests

1. Which of the following best describes your job function?

01 Administration/General management
02 Researcher
03 Project development
04 Planning/Environment consultant
05 Other (please specify) ....

2. Which of the following best describe your company or organisation? (indicate more than one if appropriate)

01 Academic Institution
02 Research Institute
03 Aid Agency
04 Private Company
05 Local/Central Government
06 Engineering Company
07 P.S.U
08 Coal Producer
09 Equipment Manufacturer
10 Coal User
11 Equipment Purchaser
12 Consultancy Organisation
13 Other (please specify) ....

3. **Please indicate the industry sector (or sectors) your organisation operates in:**

01 Coal Mining and Production
02 Power Generation
03 Steelmaking
04 Non-ferrous Metals
05 Chemicals Manufacture
06 Cement Industry
07 Other (please specify) ....

4. **Has your organisation conducted any study/project on Cleaner Coal Technology? If yes, please give brief details:**

....
....
....
....

5. **Has your organisation conducted any study/project on Cleaner Coal Technology after receiving 13 publications last year? Please specify**

....

....

....

....

6. **Did your organisation asked for more publications from ETSU UK**

Yes **No**

7. **Do you have any specific interests/requirements relating to cleaner coal technologies? If yes, please give brief details:**

....
....
....
....

8. **Have you received all 13 selected publications from the UK Cleaner Coal Technology Programme?**

01 Yes

9. Have these publications helped you in gaining further understanding of CCTs and on the CCTs offered by UK Companies?

01 Yes 02 No

10. If no, please give reasons:

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

10. 11. Would you like to receive more mail-out information on the UK Cleaner Coal Technology Programme

Yes 02 No

12. Please indicate which CCT areas you are most interested in:

Methane Drainage
Coal Handling and Supply
Coal Bending, Sizing etc
Coal Washing
Coal Briquetting
Coal Liquefaction
Coal Exploration
Coal Mining
Cement Manufacture
Coal Gasification (chemicals)
Gasification (town gas)
Industrial Boilers

☐ Power Generation (Combustion)
☐ Power Generation (Gasification)
☐ Steam Turbines
☐ Gas Turbines
☐ Conventional PF
☐ Advanced PF (Supercritical)
☐ PFBC
☐ CFBC
☐ ABGC
☐ IGCC
☐ Emissions (SO_2, NO_X, particulates)
☐ Other Industrial Coal Uses
☐ Domestic Coal Uses
☐ Other ____________________

13. Would you like to be involved in future activities such as missions to and from the UK and seminars on clean coal? If so, please specify which:

……………………………………………………………………………………

……………………………………………………………………………………

14. Any other general comments

……………………………………………………………………………………

……………………………………………………………………………………

Many thanks for your time in completing this questionnaire

Annexure I

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